HATCHER INCORPORATED

Site: ______
Break: 3.2
Other: ______

TECHNICAL MEMORANDUM

TO: Elaine Houston, U.S. EPA

FROM: Jim Knauss, Hatcher Incorporated

DATE: September 30, 1988

SUBJECT: Howe Valley Landfill
Hardin County, Kentucky
Soil Treatment Pilot Test

We are requesting permission to conduct a pilot test to establish the treatability of on-site soils contaminated with volatile organic compounds. We believe that treating these contaminated soils by aeration is the most effective alternative available and is in conformance with the intent of SARA.

Essentially, the pilot study would consist of preparing an area where approximately 50 cubic yards of contaminated soil could be treated. This would consist of constructing a run-on control structure around a 10,000 square foot area located near the area to be treated within the exclusion zone. Approximately 50 cubic yards of soil would then be transferred to this area for treatment. A composite sample of this untreated soil would be collected and sent to the laboratory and analyzed for the HSL volatile organics.

Three separate treatability plots would be prepared within the constructed treatment area. These plots will have varying depths of 6 inches, 1 foot and 2 feet to see if time or degree of treatment is affected by depth. The plots would be covered during precipitation events to prevent contamination runoff or infiltration. Each area will be "turned" by a small tractor with earth turning attachments several times a day and soil headspace analysis readings will be recorded from an OVA meter. This procedure will be continued until OVA meter readings on each plot are consistently below 10 ppm. When this condition occurs, another composite sample from each plot would be collected and sent to the laboratory for analysis.

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3150 Custer Drive, Suite 301, Lexington, Kentucky 40502 (606) 271-0269

If necessary, treatment could be continued until the desired contamination levels are reached. We anticipate that this study would last only a couple of weeks.

We have attached a report to support the decision to treat the soil by aeration. It essentially consists of two parts; one addressing the background contamination and contaminant characteristics and the second which briefly summarizes the soil handling alternatives. Although not detailed, it should provide the justification necessary at this time. Please give me a call if you have any questions.

Sincerely,
HATCHER INCORPORATED

James D. Knauss

James D. Knauss, Ph.D.
Project Manager

Attachment
JDK/pdh

HOWE VALLEY LANDFILL
HARDIN COUNTY, KY

SOIL HANDLING
DOCUMENTATION

Hatcher Incorporated
Lexington, Kentucky
September 30, 1988
Job No. 0064-001

CONTAMINANT FATE AND TRANSPORT

The contaminants at the Howe Valley Landfill Site discussed below include those found in the environment (ponds, streams, sediment and soil) during the Remedial Investigation. They represent constituents which could potentially pose a threat to human health or to the environment and therefore, they have been designated as potential contaminants of interest. The actual contaminants of interest will be selected based upon their presence, concentrations, toxicity, and their potential to impact human health and/or the environment.

PROPERTIES OF ENVIRONMENTAL CONTAMINANTS

Contaminants found in the soil, sediments or water (which were not treated on-site) at the Howe Valley Landfill and their major properties are presented on Table 1. The potential contaminants of interest consist of:

- Five volatile organic compounds
- Three base/neutral extractable organic compounds (the phthalates)
- One acid extractable organic (4-methylphenol)
- Two inorganic metals (chromium and zinc)

INORGANIC METALS

It should be noted that the two metals which have been included as contaminants of interest have not been found in the site environment outside of normal soil concentrations for the United States (U.S. EPA, 1986). They were included only because they were found in high concentrations in the drummed blue-grey plating sludge waste buried on-site.

ACID EXTRACTABLE ORGANIC COMPOUNDS

The one acid extractable organic compound, 4-methylphenol, was detected only one time (May 31, 1988) at one of the ponds at 4 ppb in the water and 4 ppm in the sediment. It is used in essential oils of perfumes and flavoring oils (Sax, 1984). Because it was not found associated with other wastes on-site, it was probably contained with the discarded household trash disposed of by area residents. In any event, due to its limited presence, relatively low concentration, and use in perfumes and flavoring, it will not be considered further as a contaminant of interest.

BASE/NEUTRAL EXTRACTABLE ORGANIC COMPOUNDS

Three phthalates were detected in the soil and sediment at the Site. One of these, di-n-butyl phthalate, was found in less than 1 ppm concentrations in all but one sample, including background samples and laboratory quality control samples. Therefore, the presence of di-n-butyl phthalate at the Site is suspected to be the result of laboratory contamination.

Diethyl phthalate was not found in any of the wastes but was detected in two of the soil samples in concentrations of 1 ppm or less. It could possibly represent a biodegradation product of bis (2-ethylhexyl) phthalate.

Bis (2-ethylhexyl) phthalate was the most prevalent of the three phthalates found at the Site. The major source of this compound appears to be from the Celotex insulation disposed of at the landfill. Three composite analyses from the insulation had bis (2-ethylhexyl) phthalate concentrations ranging from 1,500 to 2,400 ppm. This compound is almost insoluble in water; in fact, the reported solubility of 1.3 mg/l is more than 15 times less than the Clean Water Act, Water Quality Criteria for Human Health (Drinking Water only) of 21 mg/l. The compound also has a very high Octanol/Water Partition Coefficient which means that it is retained by organic matter in the soil which would limit its migration. Both of these properties were apparent at the Site by the fact that it was found in highest concentrations (11 ppm) in the soil immediately below the Celotex insulation pile, found in sediment and soil in other areas at concentrations of less than 1 ppm and not found in the on-site pond water. Additionally, it is not a very persistent compound with biodegradation considered an important fate process. Therefore, due to this group's low concentrations, relatively low toxicities, and limited mobility, this group will no longer be considered as contaminants of interest.

VOLATILE ORGANIC COMPOUNDS (VOCs)

The volatile organic compounds were found in the greatest number had the highest concentrations of any other group and, therefore, represent the most important group of compounds at the Site. All of the compounds represented are slightly soluble with solubility coefficients ranging from 130 to 4,400 ppm. Their primary transport process is volatilization while the predominant environmental process determining fate is oxidation. Persistence in this particular VOC group is low with a half-life generally ranging from hours to a few days (U.S. EPA, 1979). The only exception is for 1,1,1-trichloroethane which is considered moderately persistent with a half-life from 5 months to 8 years (U.S. EPA, 1979 and 1987).

The current standards, criteria and toxicity data for these volatile organic compounds is presented in Table 2. The air quality limits are those established by the Occupational Safety and Health Administration (OSHA) and represent the maximum allowable 8-hour weighted average exposure (Time Weighted Average or TWA) for humans.

The oral LD50 toxicity data was taken from Sax (1984) and represents the lowest oral toxicity value reported for that compound. The corresponding toxicity value for humans was derived by the following formula (U.S. EPA, 1987):

$$D_H = (D_A)(W_A/W_H)^{1/3}$$

where D_H = the human equivalent dose (mg/kg)

D_A = the animal dose (mg/kg)

W_H = human body weight (kg)

W_A = animal body weight (kg)

The Maximum Contaminant Level (MCL) is from U.S. EPA's published values or proposed (U.S. EPA, 1988) limits. Additional criteria have been included from the Safe Drinking Water Act (SDWA) and Clean Water Act (CWA).

Two volatile organic compounds, 1,1,1-trichloroethane and tetrachlorethene, were consistently found in higher concentrations in the Site soil than the other compounds. These two compounds also are the most toxic compounds of the group and are quite representative of the group's solubility. Therefore, these two compounds have been selected as the contaminants of interest for the Site soil.

POTENTIAL ROUTES OF CONTAMINANT MIGRATION

Contaminants disposed of at the Howe Valley Landfill can enter the environment through several different routes. Initially, the chemicals in the wastes disposed of directly in the landfill or which have leaked from rusted drums would contaminate the soil around them. Any contaminants in the surface soil could migrate with runoff either adsorbed to soil particles or dissolved in the water. At the Site, there are no streams flowing off-site, but the runoff could contaminate on-site ponds and sediment or flow into the sinkhole. Contaminants in the soil could also be leached to the groundwater. These contaminants could migrate off-site through the network of solution channels present as a result of the karst conditions at the Site and eventually reach a base level discharge point. The final potential migration source would be through the air by wind derived particulates containing the contaminants or through direct volatilization of organic compounds.

SOIL HANDLING ALTERNATIVES

Several potentially workable alternatives exist for handling the soil at the Howe Valley Landfill. These alternatives include: No Action; Off-Site Disposal (Landfill or Incineration); or On-Site Treatment and Disposal (Incineration or Aeration). Each of these alternatives, with the exception of No action, essentially meets the major criteria for effective remediation, i.e., short-term and long-term effectiveness; reduction of toxicity, mobility and volume; implementability; protection of human health and the environment; and compliance with ARARs. Therefore, only the major differences have been highlighted in the following sections.

NO ACTION

The No Action Alternative would essentially consist of doing nothing with the soil except possibly recontouring as needed. Some contaminated soil was excavated in association with the small containers and non-containerized silicone wastes and temporarily stored and then disposed off-site. However, some areas may still exist which could have several hundred parts per million total volatile organics. As a result, some potential for contamination may exist from these areas.

OFF-SITE DISPOSAL ALTERNATIVES

Two potentially workable alternatives exist for the off-site disposal of contaminated soil. The two options include landfilling at a hazardous waste landfill or incineration. These alternatives are addressed separately below.

Landfilling

As indicated earlier, landfilling essentially meets the major criteria for effective remediation. However, since the material would be transported to an off-site location, there would still be some short and long-term residual risk associated with this option. Additionally, while the contaminant mobility would be reduced at a hazardous waste landfill, the soil would not be reduced with regard to toxicity or volume.

Incineration

The off-site incineration alternative would result in an improvement of the long-term effectiveness criteria. Additionally, toxicity, mobility and volume would be effectively reduced. Since the alternative includes transporting the soil off-site, a short-term risk would still exist. The major drawback to this alternative is that it represents a significantly higher cost than the other alternatives.

ON-SITE TREATMENT AND DISPOSAL

There are essentially two workable alternatives within this category; incineration or treatment by aeration. A third alternative could be proposed which would include aeration combined with biodegradation. However, since the chemicals of interest can be effectively treated by aeration alone, no appreciable benefits would be derived by this option and the increased costs would not justify the incremental benefits.

Incineration

On-site incineration is possibly the most effective soil handling alternative in terms of overall degree of compliance with the evaluation criteria. Since treatment would occur on-site, it would be more effective in the short-term than off-site incineration and, hence, generally more protective of human health and the environment. Implementability, while feasible, may be somewhat more difficult than the other alternatives. The major drawback with this option, as was the case for off-site incineration, is its associated high costs.

Aeration

On-site treatment by aeration is also a very effective soil handling technique for this particular Site, although perhaps not quite to the same degree as on-site incineration for all criteria. It does possess a couple of advantages, however, in the areas of implementation and costs. No exotic equipment is necessary to implement this alternative and the costs are significantly lower than any of the other alternatives with the exception of "No Action".

One possible area of concern with this type of treatment involves air pollution from the volatilization of the organic compounds. However, if we assume that there is 5,000 tons of contaminated soil to be treated which averages 200 ppm of total volatile organics, the amount of organics released during treatment would only be 1 ton. Significant emissions or increases in emissions for PSD review is considered to be 40 times greater or 40 tons/ year. The de minimus impact exemption from monitoring is 100 tons/year or 100 times greater than assumed for the Site. Therefore, even if the above estimates are somewhat low, any off-site air pollution from the release of volatile organic compounds should not be a problem during the aeration of the contaminated soils.

COMPARISON OF SOIL HANDLING ALTERNATIVES

Based upon the above discussion, a subjective comparison between the different soil handling alternatives was prepared (Table 3). This numerical comparison is based upon "1" being the better of the options for the particular criteria and "3" representing the least effective in meeting the criteria.

It should be noted that even though the subjective numerical values ranged from 7 to 11 for the workable alternatives, the actual effectiveness for each of these four options are quite similar. The off-site alternatives essentially scored higher because of a very low potential risk for contamination occurring as a result of taking the contaminants off-site.

The four alternatives, however, differ quite significantly with regard to costs. The following cost scenario was prepared to provide "order of magnitude" costs associated with each alternative:

- o Landfill costs were estimated at $170/ton.
- o Off-site bulk incineration costs of about $810/ton.
- o On-site incineration costs at about $420/ton. (Note: Significant reductions in cost occur with greater amounts of soil).
- o Aeration costs of approximately $30/ton.

If it is assumed that the amount of soil to be treated and/ or disposed is 5,000 tons, the following costs can be derived:

Landfilling - $850,000

Off-Site Incineration - $4,050,000

On-Site Incineration - $2,100,000

Aeration - $150,000

Therefore, the most cost-effective approach, considering protection of human health and the environment, is the aeration treatment alternative. It effectively meets all of the criteria established by EPA for the evaluation of alternatives.

TABLE 1

PROPERTIES OF HAZARDOUS OR TOXIC ENVIRONMENTAL CONTAMINANTS

Hazardous Constituents	Hazardous Waste #	Density (gm/cm3)	Molecular Weight	Water Solubility Qualitative	PPM	Octanol/Water KOW	Vapor Pressure (Torr)	Melting Point C.760Torr	Boiling Point C.760Torr	Sax Toxicity
Bis (2-ethylhexyl) phthalate	U028	0.985	391.0	almost insol.	1.3@25C	5.3	2x10E7@20C	-50	387@5	3-2-1
Di-n-butyl phthalate	U069	1.047	278.34	almost insol.	13@25 C	5.2	0.1@115 C	-35	340	3
Diethyl phthalate	U088	1.1175	222.23	sl. soluble	1800@32 C	3.22	0.05@70 C	-40.5	298	3
Ethylbenzene	NA	0.8669	106.18	sl. soluble	152@20 C	3.15	7@20 C	-94.9	136.2	2-1
4-Methylphenol	U052	1.034	108.15	soluble	2500@50 C	2.70	1@53C	35.5	201.8	3
Tetrachloroethene	U210	1.623	165.83	sl. soluble	200@20 C	2.88	14@20 C	-22.7	121	3
Toluene	U220	0.886	92.13	sl. soluble	534.8@25 C	2.07 2.69	28.7@25 C	-95	110.6	3
1,1,1-Trichloroethane	U226	1.332	133.41	sl. soluble	4400@20 C	2.2	96.0@20 C	-30.41	74.1	2-1
Xylene (o-)	U239	0.88@25C (sp.gr.)	106.2	sl. soluble	175@25 C	2.95	10@32.1 C	-25.5	144.4	3-2
(m-)		0.8684@15C (sp.gr.)	106.2	sl. soluble	130@20 C	3.26	10@28.3 C	-47.9	139	3-2
(p-)		0.86@25C (sp.gr.)	106.2	sl. soluble	198@20 C	3.15	10@27.3 C	13-14	138	3-2-1
Chromium	NA	7.19	52.00	insol./sol.	variable	NA	Neg.	1875	2665	NA
Zinc	NA	7.14	65.37	insol./sol.	variable	NA	Neg.	419.5	906	NA

TABLE 2

CURRENT STANDARDS, CRITERIA AND TOXICITY DATA
FOR VOLATILE ORGANIC CONTAMINANTS

Volatile Organic Contaminant	OSHA TWA (ppm)	Oral LD50 Toxicity (mg/kg)	MCL/SDWA/CWA (mg/L)
Ethylbenzene	100	Rat-3,500 (Human-497)	0.7*/-/2.4
Tetrachloroethene	100	Rat-8,850 (Human-1,256)	0.005*/0.02/0.00088
Toluene	200	Rat-5,000 (Human-710)	2*/0.34/15
1,1,1-Trichloroethane	350	Dog-750 (Human-416)	0.2/1.0/19
Xylene	100	Rat-4,300 (Human-610)	10*/0.62/-

*Proposed MCLs.

TABLE 3

SUBJECTIVE COMPARISON OF SOIL HANDLING ALTERNATIVES
WITH EFFECTIVENESS CRITERIA

	Short-Term Effectiveness	Long-Term Effectiveness	Reduction of Toxicity, Mobility and Volume	Implementability	Protection of Human Health & Environment	Costs	Totals
NO ACTION	3	3	3	3	3	1	16
OFF-SITE							
Landfill	2	2	2	1	2	2	11
Incineration	2	1	1	1	2	3	10
ON-SITE							
Incineration	1	1	1	1	1	3	8
Aeration	1	1	1	1	1	2	7

1 = Most Effective
2 = Less Effectiveness
3 = Least Effective

REFERENCES

Sax, N.I., 1984. Dangerous Properties of Industrial Materials. Van Nostrand Reinhold Company, NY. 3124 pp.

U.S. EPA, 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Volumes I & II. EPA-440/4-79-029 a & b.

U.S. EPA, 1986. Reclamation and Redevelopment of Contaminated Land: Volume 1., U.S. Case Studies, Hazardous Waste Engineering Research Laboratory, Cincinnati, Ohio. 186 pp.

U.S. EPA, 1987. Toxicology Handbook. Government Institutes, Inc., Rockville, MD. ISBN No. 0-86587-142-6.

U.S. EPA, 1988. EPA's Draft Federal Register Notice which includes Maximum Contaminant Level Goals (MCLGs) and National Primary Drinking Water Regulations for 30 Synthetic Organic Chemicals and 9 Inorganic Chemicals. 473 pp.